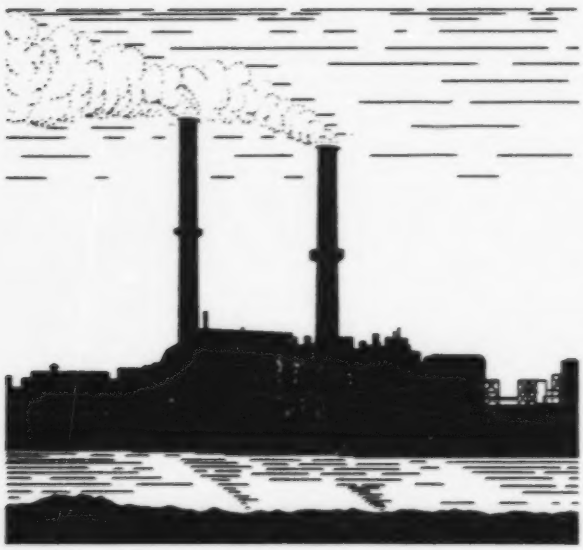
Environment Canada Environnement Canada

FIRST ANNUAL REPORT ON THE FEDERAL - PROVINCIAL AGREEMENTS FOR THE EASTERN CANADA ACID RAIN PROGRAM



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ABSTRACT

This Report provides a summary of the progress to March 31, 1990 of the Eastern Canada Acid Rain Control Program. The program includes seven federal-provincial agreements. Its objective is to reduce SO_2 emissions in eastern Canada by 50 percent from 1980 baseline levels. The program requires reductions of SO_2 emissions from non-ferrous smelters, fossil fuel burning power plants, and industrial/commercial boilers.

In 1980, baseline SO_2 emissions were 4516 kilotonnes. Estimated SO_2 emissions in 1987 were 3066 kilotonnes, a reduction which indicated that 65 percent of the progress needed to attain the 1994 target of 2300 kilotonnes had been achieved. Additional reductions may be expected with confidence as major capital projects, which are under way or committed to, are completed.

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SUMMARY

In response to the serious threat posed to much of eastern Canada by acidic deposition, in 1985 the federal government and the governments of the seven easternmost provinces agreed to establish a program to reduce emissions of sulphur dioxide (SO_2), the primary cause of acid rain.

This program, formalized in federal-provincial agreements signed in 1987 and 1988, established specific targets and timetables for reducing emissions in each province. The federal government undertook to seek reductions in transboundary flows of SO_2, and to support research and development into, and the demonstration of, SO_2 reducing technologies.

The program requires that total annual SO_2 emissions from the provinces east of Saskatchewan be reduced to 2300 kilotonnes by the end of 1994, a decrease of about 50 percent from the 1980 baseline level of 4516 kilotonnes. Each province agreed to a specific overall reduction target and timetable. In general, control efforts have been directed at major SO_2 sources, such as non-ferrous metal smelters and fossil fuel burning power plants, where the largest and most cost-effective reductions can be achieved. These sources emitted about 50 and 20 percent, respectively, of Canada's SO_2 emissions in 1985. As a result, six large copper, nickel and zinc smelters, one iron ore sintering plant, and three provincial electrical utilities are responsible for implementing the major portion of the control program. Both federal and provincial governments have also been active in supporting research, development and demonstration of technologies to control SO_2 emissions at source. The 1987 data on Canadian SO_2 emissions, the most recent available, indicate that about 65 percent of the program target of reducing emissions to 2300 kilotonnes has already been achieved.

1. INTRODUCTION

Acid rain, or more correctly, acidic deposition, emerged as a serious regional scale environmental problem in the 1970s. Research at the time revealed that a large number of lakes in eastern Canada were being acidified by pollutants such as sulphur doxide (SO_2) and oxides of nitrogen (NOx), which were being deposited in wet and dry form. The SO_2 emissions were determined to be coming from smelters and power plants in Canada, and from sources in the United States. NOx emissions mainly from fuel combustion and vehicles are not considered to be the major cause of acidification in eastern Canada.

Canadian researchers also determined that a reduction of excess wet sulphate deposition to less than 20 kilograms per hectare per year would be required to protect all but the most sensitive lakes in much of eastern Canada. The achievement of this goal required a halving of SO_2 emissions in eastern Canada and of transboundary flows into the region from the United States.

These findings led to the establishment of provincial programs to reduce Canadian SO_2 emissions, and to ongoing efforts by the government of Canada with support from the provinces and nongovernmental organisations, to reduce transboundary flows from the United States. As part of its international efforts, Canada has also signed the 1985 Economic Commission for Europe protocol on SO_2, which requires a 30 percent SO2 reduction nationally from 1980 levels by 1993.

This Report, mandated under the federal-provincial agreements on acid rain, describes the progress made to March 31, 1990 in reducing SO2 emissions under the Eastern Canada Acid Rain Control Program.

2. THE EASTERN CANADA ACID RAIN CONTROL PROGRAM

The Eastern Canada Acid Rain Control Program is based on the concept of "critical load". Canadian scientists determined that a reduction in wet sulphate deposition to 20 kilograms per hectare per year is sufficient to protect all but the most sensitive lakes. The Canadian program is designed to reduce emissions to levels so that wet sulphate-deposition rates do not exceed 20 kilograms per hectare per year.

In establishing the acid rain control program, Canada adopted a cooperative federal-provincial strategy. Discussions between the seven eastern provinces and the federal government resulted in the setting of an overall reduction target, and the allocation of specific reduction requirements to individual provinces; these are summarized in Table 3.1. The results of the discussions were subsequently formalized in federal-provincial agreements which were signed in 1987 and 1988:

--Newfoundland agreed to reduce its total SO_2 emissions to a target of no more than 45 kilotonnes by 1994, and to require state-of-the-art SO_2 controls for new sources. The province also committed itself to continue efforts to encourage alternative fuel use and energy conservation.

--Prince Edward Island agreed not to exceed an annual emission objective of 5 kilotonnes by 1994. The province also undertook to encourage the use of alternative fuels and to conserve energy.

--Nova Scotia committed itself to reduce total provincial SO_2 emissions to a target of no more than 204 kilotonnes by the end of 1994. The province also agreed to negotiate specific reductions for individual large sources of emissions.

--New Brunswick committed itself to an SO_2 target of 185 kilotonnes by the end of 1994, and to negotiate specific reductions and timetables for achieving major source targets.

--Quebec agreed to ensure that its total SO_2 emissions would not exceed a 600 kilotonne annual objective by 1990, and to encourage alternative energy use and conservation.

--Ontario committed itself to an SO_2 emissions cap of no more than 885 kilotonnes per year by 1994. Ontario's agreement also includes specific SO_2 control regulations for four major sources and sulphur content in fuels.

--Manitoba agreed to reduce its SO_2 emissions to a target of no more than 550 kilotonnes per year before the end of 1994, by ordering appropriate reductions at major SO_2 sources.

For its part, the federal government undertook to investigate new technologies with the potential to reduce SO_2 emissions, and opportunities for fuel switching. The federal government was also to address the issue of the transboundary flow of pollutants into Canada from the United States.

Table 3.1 Eastern Canada SO_2 Emissions and Objectives (kilotonnes)

	1980 baseline	1980 actual	1985 (actual)	1987 (actual)	1994 (limits)
Newfoundland					
- Power Generation	-	18	22	20	-
Total	59	56	43	51	45
Prince Edward Island					
- Total	6	4	2	3	5
Nova Scotia					
- Power Generation	-	125	130	135	-
- Total	219	193	170	178	204
New Brunswick					
- Primary Metals	-	13	17	21	-
Power Generation	-	122	94	158	-
Total	215	220	138	216	185
Quebec					
- Primary Metals	-	641	502	463	-
Total	1085	1098	693	660	600
Ontario					
- Primary Metals	-	1031	899	816	-
Power Generation	-	398	337	332	-
Total	2194	1764	1457	1399	885
Manitoba					
- Primary Metals[2]	-	463	459	539	-
Total	738	484	469	559	550
Eastern Canada					
- Primary Metals[2]	-	2148	1844	1839	-
Power Generation	-	667	585	648	-
Total	4516	3819	2972	3066	2300[1]

Notes: [1] The 1994 Eastern Canada limit is 2300 kilotonnes. The current total of agreed-to objectives is 2474 kilotonnes; the remaining 174 kilotonnes is expected to be allocated by 1991.

[2] Primary Metals includes non-ferrous smelters, and iron and beneficiation, but excludes aluminum production.

3. SO_2 CONTROL MEASURES AND STRATEGIES

Emission reductions to date have been achieved primarily by targeting major sources of SO_2. The focus has been on using effective and proven technologies to reduce emissions from smelters, power plants and other sources.

Quebec and Ontario have adopted a mix of regulatory actions and other methods, while the remaining provinces have dealt with large individual sources on a case by case basis. Table 3.1 summarizes emission baselines and limits for each province, and indicates historical emissions from the major source sectors targeted. It should be noted that the baseline 1980 levels used as a reference in the federal-provincial agreements reflect SO_2 emission limits already in place at the beginning of the program. The most recent year for which a comprehensive estimate of eastern Canadian SO_2 emissions is available is 1987. Total 1987 emissions of 3066 kilotonnes are 32 percent less than the 1980 baseline level; this represents roughly 65 percent of the agreed-to reduction, half way through the program.

The measures constituting the program have been applied or are expected to be implemented within the next four years. Canadian industry in general, and the metals industry in particular, has been active in employing new energy and resource efficient technologies. Canada's larger smelters have undertaken major multi-year modernization programs incorporating pyrrhotite separation techniques, advanced smelting technologies, and sulphur recovery as liquid SO_2 or sulphuric acid.

By 1994, updated, modernized and more efficient processes will be in place at Canadian non-ferrous smelters. A circulating fluidized bed power plant will be built in Nova Scotia. Flue gas scrubbers, likely of the wet limestone type, are planned or are under construction at several power plants in Ontario and New Brunswick; these may be also designed to produce commercial quality gypsum. Canadian electric utilities are also pursuing conservation and demand management programs as an integral part of their planning processes.

Figure 3.1 shows total SO_2 emissions in Canada from 1975 to 1987, and in eastern Canada by sector from 1980 to 1987, relative to the 1994 SO_2 objective.

Figure 3.2 compares SO_2 emissions in Canada with those in the United States. In Canada, most SO_2 emissions are produced at nonferrous metal smelters and as a result of fuel combustion in power plants and by industry. In the United States, most emissions come from fuel combustion in power plants. In 1985, Canadian SO_2 emissions were about 18 percent of those in the United States, although the Canadian population is only about one tenth as large. The higher per capita emissions in Canada are mainly attributable to the dominant role played by a few large non-ferrous smelters. This situation is changing as the major Canadian non-ferrous smelters complete their SO_2 control programs.

Figure 3.1: SO_2 Emissions in Canada
1975-1987

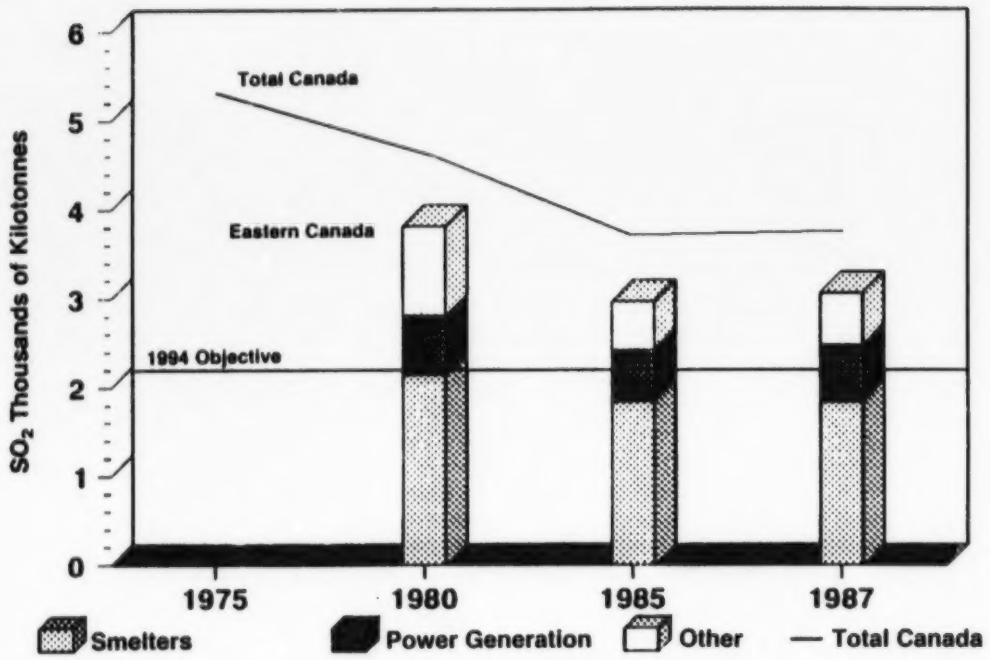
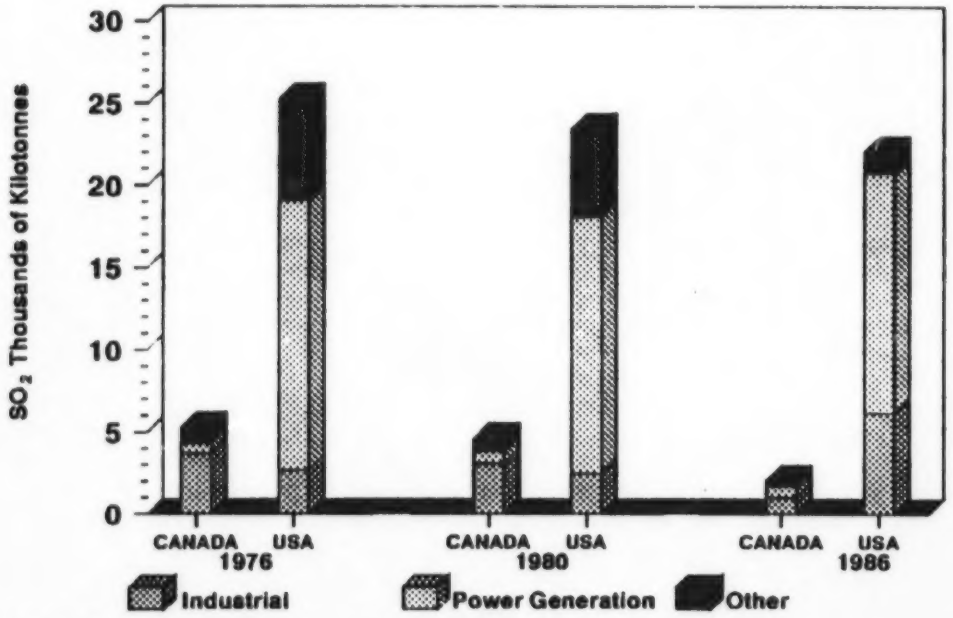


Figure 3.2: Canadian Emissions in the North American Context
1976-1985



Industrial includes metal smelting; US emissions – NAPAP/90

4. PROGRAM IMPLEMENTATION

The provincial governments have, for the largest sources, instituted specific requirements for SO_2 emission reduction. Each province has tailored its program to reflect the mix of sources within its jurisdiction and to reflect the technical conditions and constraints pertaining to specific sources. While most acid rain control program measures are directed at smelters and power plants, other sources have also been targeted by some provinces through measures such as sulphur in fuel limitations or emission limits from industrial processes.

Smelters. Prior to the establishment of the federal-provincial acid rain program, three smelters had already installed equipment to reduce SO_2 emissions: Kidd Creek Mines at Timmins, Ontario; Canadian Electrolytic Zinc at Valleyfield, Quebec; and Brunswick Mining and Smelting at Belledune, New Brunswick. A sulphuric acid plant which was already in operation at the Noranda Murdochville Quebec plant was upgraded. As part of the acid rain control program, the provinces established plant specific emission limits for the six remaining smelters which were responsible for the largest amounts of SO_2 emissions. Table 4.1 summarizes regulatory limits and emissions with regard to these nine smelters in eastern Canada.

Table 4.1 SO_2 Emissions and Limitations: Primary Metals Smelters (kilotonnes of SO2)

	1970	1980[1] (baseline)	1985	1987	1994[2] (regulated limits)
Manitoba					
- INCO (Thompson)	458	414	188	251	220
Hudsons Bay Mining and Smelting (Flin Flon)	265	293	270	322	220
Ontario					
- INCO (Copper Cliff)	1922	1155	695	659	265
Falconbridge (Sudbury)	342	154	75	72	100
Kidd Creek Mines (Timmins)	-	-	4	-	4
Quebec					
- Canadian eletrolytic (Valleyfield)	3	-	5	6	-
- Noranda (Horne)	619	552	438	432	276
- Noranda (Murdochville)	154	91	43	45	65
New Brunswick					
- Noranda (Belledune)	24	-	17	17	-

Notes: [1] - 1980 baseline levels are the basis for the reductions under the federal-provincial agreements.

[2] - Regulated limits for 1994 will be provincially imposed.

Power Plants. Ontario, New Brunswick and Nova Scotia have established programs to reduce SO_2 emissions from their large fossil fuel burning power plants. While fossil fuel burning plants also exist in Quebec, Prince Edward Island and Newfoundland, for the most part these produce a relatively lower proportion of emissions relative to the 2300 kilotonne limit. Manitoba does not have any significant fossil fuel burning power stations. Emissions statistics and provincially imposed emission limits on power plants are summarized in Table 4.2.

Table 4.2: SO_2 Emissions and Limitations: Power Generation (kilotonnes of SO_2)

	1980 (baseline)	1985	1987	Utility Emissions Limits
Manitoba	2.8	3.5	4.0	
Ontario	397.8	337.0	332.0	175
Quebec	1.3	0.4	-	
New Brunswick	122.3	94.0	158.0	130
Nova Scotia	125.2	130.0	135.0	160
Prince Edward Island	2.0	2.0	3.0	
Newfoundland	18.0	22.0	20.0	
Total Eastern Canada	669.4	588.9	652.0	

Sources:
- Emissions and Trends of Common Air Contaminants in Canada: 1970 to 1980, Environment Canada; Sept., 1986
- Canadian Emissions Inventory of Common Air Contaminants (1985) Environment Canada, March 1990.

Note: In Manitoba, and Quebec, thermal electricity generation is not a major source of SO_2 emissions. In Prince Edward Island and Newfoundland power generation emissions are variable, depending on the need for thermal generation in-province.

1987 emission figures are taken from provincial reports prepared as part of the federal-provincial agreements.

5. PROVINCIAL ACTIONS

Manitoba

Manitoba issued licences under the Environment Act which set specific emission limits for two smelters: 220 kilotonnes at the International Nickel Company (INCO), LTD., smelter at Thompson; and 220 kilotonnes at the Hudson Bay Mining and Smelting operation at Flin Flon.

Ontario

Under its "Countdown Acid Rain Program" Ontario has undertaken a range of actions to reduce SO_2 emissions. The province established plant specific smelter emission limits for INCO at Copper Cliff and Falconbridge, Ltd. at Sudbury. As noted, the Kidd Creek Mines operation at Timmins recovers 96 to 98 percent of the sulphur contained in its ores.

With regard to power plants, Ontario Hydro has a total generating capacity of approximately 32000 megawatts, of which roughly 30 percent is coal fired. Ontario Hydro is obligated by provincial regulation to meet increasingly stringent levels of control, which by 1994 will cap SO_2 emissions at 175 kilotonnes. Ontario Hydro has to date been able to reduce its emissions by minimizing use of its fossil fuel burning plants in favour of nuclear generation, the purchase of energy from adjacent utilities, mainly in Quebec and Manitoba, and by burning low sulphur fuels.

Sources other than power plants and smelters account for approximately 30 percent of total Ontario SO_2 emissions. Accordingly, the Algoma Steel Corporation's iron ore sintering plant at Wawa was required to reduce its annual SO_2 emissions limit from 285 kilotonnes to 180 kilotonnes in 1986, and to 125 kilotonnes for 1994. To reduce SO_2 emissions from fuel combustion, Ontario has also issued regulations limiting the sulphur content of fuel used in new or modified commercial boilers to one percent, unless an equivalent emission level is achieved by removing SO_2 from flue gases.

Quebec

Quebec established plant specific emission limits of 276 and 65 kilotonnes respectively for two non-ferrous smelters of Noranda Minerals, Inc., at that company's Horne and Murdochville operations. The Canadian Electrolytic Zinc refinery at Valleyfield began reducing emissions prior to the start of the federal-provincial control program. The province's electric utility, Hydro-Quebec, is an overwhelmingly hydro based electricity producer. It has only one oil burning steam plant, at Tracy; a plant usually run only at peak times and during emergencies.

While the Tracy plant has been more heavily utilized lately, due to unusually low precipitation levels, such conditions are not likely to persist. Nevertheless, Hydro-Quebec agreed to reduce the sulphur content of the oil burned at Tracy to 1.5 percent, as of December, 1989 and to cap its SO_2 emissions. In 1988, miscellaneous combustion, industrial and transportation sources accounted for about 35 percent of provincial SO_2 emissions. Quebec has established a system of plant specific limits on SO_2 emissions from paper making processes and from pulping liquor recovery operations. Quebec has adopted more stringent sulphur in fuel limits of 1.5 percent for new, and of 2 percent for existing, facilities.

New Brunswick

The Brunswick Mining and Smelting operation at Belledune had implemented 85 percent efficient sulphur emission controls prior to the start of the federal-provincial control program. New Brunswick has an electricity generating capacity of about 3500 megawatts: 45 percent oil, 10 percent coal, the balance hydro and nuclear.

New Brunswick Power is heavily interconnected with its neighbours, notably Hydro-Quebec. It had historically been able to minimize its use of fossil fuel generation and the resulting SO_2 emissions by using its nuclear generation and through purchases from Quebec. New Brunswick Power is required to reduce its SO_2 emissions below 130 kilotonnes by 1994. The utility's current development program is largely based on the use of coal and other fossil fuels and includes Canada's first flue gas desulphurisation system at the new Belledune power plant.

New Brunswick sources other than smelters and power plants account for less than 20 percent of provincial emissions; most notably pulp and paper mills and industrial fuel combustion. The last two of New Brunswick's eleven pulp mills are completing extensive modernizations begun by the industry in the early 1980's. These are expected to be completed early in 1991. It is anticipated that this sector, despite growth pressures, will maintain SO_2 emission levels of less than 15 kilotonnes per year without additional regulatory measures. The Irving Oil refinery in Saint John is meeting the SO_2 emission limit of 8 kilotonnes which was imposed at the time of its last expansion.

Nova Scotia

Nova Scotia Power has a total capacity of about 2000 megawatts, of which about 70 percent is coal burning. The utility is obligated to emit no more than 160 kilotonnes of SO_2 in 1994. As a first step toward achieving this goal, Nova Scotia Power has increased its use of lower sulphur and cleaned coal. A 150 megawatt circulating fluidized bed power plant is to be built.

In Nova Scotia, sources other than power plants, mainly industrial fuel combustion and industrial processes, account for a little over 20 percent of SO_2 emissions. The province is currently reviewing SO_2 sources which may release over 100 tonnes per year to determine if additional measures are needed. Research is also being conducted on clean fuels to substitute for the high sulphur oil and coal which are being used at present in some industrial facilities.

Newfoundland

In Newfoundland, most electricity is generated by Newfoundland and Labrador Hydro, and most production facilities are hydro-based. However, the province's largest single hydro site, and most of its undeveloped hydro resources, are located in Labrador. These are unconnected to the island of Newfoundland proper, where most consumers are situated . The island's electrical system, having maximized locally available hydro potential, is dependent on oil fired generation to supply electricity in periods of low water, or when demand is particularly strong. With increasing future demand, the use of oil will increase until a transmission link to Labrador's hydro sites is built. Meanwhile, Newfoundland and Labrador Hydro will comply with provincially imposed SO_2 emission limits by using low sulphur fuel.

Prince Edward Island

Prince Edward Island's utility is Maritime Electric, with about 120 megawatts of oil fired generating capacity. For economic reasons, most electricity is purchased from New Brunswick Power, and is transmitted to the island via underwater cable. Maritime Electric's own capacity is used during periods of high demand, during emergencies, or when energy is unavailable from New Brunswick. To limit SO_2 emissions, Maritime Electric can opt to use low sulphur fuels in the event that it must generate a significant amount of its own energy.

6. FEDERAL ACTIVITIES

Internationally, Canada has continued to pursue its goal of concluding a Canada-United States accord on the long range transport of air pollutants. Canadian scientists also participated in evaluating the United States' National Acid Precipitation Assessment Program.

On the national front, federal efforts have been directed at technology development and demonstration and transfer. Federal assistance has been provided to a number of smelters to research and implement improved milling, beneficiation and smelting technologies. Federal support is channelled through the Department of Industry, Science and Technology's Industry Research and Development Program.

Other federal initiatives to reduce SO_2 emissions from major fuel burning sources have focused on technology transfer and demonstration. Most of this work has been carried out under the Coal Utilization Program, administered by agencies within the federal Department of Energy, Mines and Resources.

Technologies which have been supported include coal beneficiation, coal-water mixtures, sorbent injection, advanced slagging combustors, and fluidized bed combustion. Major projects include: fluidized bed combustion demonstrations at Chatham, New Brunswick and Summerside, Prince Edward Island; coal-water and coal-oil mixture combustion trials at Charlottetown, Prince Edward Island and Chatham, New Brunswick; projects in eastern and western Canada on coal beneficiation; demonstration of limestone and sorbent injection with Ontario Hydro and Saskatchewan Power; and research on treatment, disposal and utilization of by-products from SO_2 removal technologies.

7. HIGHLIGHTS OF ACTIONS IN 1989/90

The year 1989-90 saw interesting developments to control SO_2 emissions in both the private and government sectors. Among them:

- **In Manitoba**, INCO Ltd. released a report indicating the pyrrhotite rejection process as the most economical method for controlling emissions at the Thompson smelters. The Hudson Bay Mining and Smelting Co. decided to convert the existing zinc smelter process to pressure leaching and to modernize the copper smelter. Discussions regarding funding for the changes are proceeding.

- **In Ontario**, Ontario Hydro released its demand/supply plan for the next 25 years. In the context of rising demand, the utility has opted to equip its coal burning power plants with flue gas desulphurization, beginning with a commitment to build scrubbers at two existing 500 megawatt units of the Lambton coal burning power plant by 1994. In the interim, flue gas conditioning equipment is being installed at Lambton and Nanticoke, to allow their units to use low sulphur coal. As well, the modernization of the Inco smelting facilities at Copper Cliff continued, with completion scheduled for late 1994.

- **In Quebec**, a major sulphuric acid plant was completed at the Noranda Horne smelter. As well Hydro Quebec established a limit on the sulphur content of the heavy oil it uses at the Tracy plant at 1.5 percent.

- **In Brunswick,** New Brunswick Power began construction of a 450 megawatt coal burning power plant at Belledune. This facility, to be completed by 1994 will incorporate a flue gas desulphurization system with a 90 percent nominal efficiency and will comply with federal standards for new steam electric power plants. Future plants will also be equipped with scrubbers or use advanced technologies, such as combined cycle coal gasification, which have equal or better environmental performance. In addition, New Brunswick Power restated its intention to convert 350 megawatts of oil fired capacity at Coleson Cove to "orimulsion" with a 90 percent efficient scrubber or, alternatively, to use low sulphur fuel oil.

Studies of the Brunswick Mining and Smelting plant at Belledune indicate that additional measures, such as changes in the smelting process, are required. Decisions on the approaches to be taken are expected shortly.

- **In Nova Scotia,** Nova Scotia Power committed itself to the construction of a 150 megawatt circulating fluidized bed unit at Point Aconi. The technology chosen for the plant must achieve 90 percent SO_2 capture, and will comply with federal performance standards for new steam electric power plants.

- **The Federal Government** continued to conduct technical research and to pursue SO_2 reductions through other means.

Research activities at the Canada Center for Mineral and Energy Technology included:

- Investigations into the development of ceramic-based high temperature temperature sensors for use in pyrometallurgical processes. These are expected to facilitate the control of smelting and converting processes and of the gases being sent for SO_2 fixation in sulphuric acid plants;

- Research on coal gasification. Construction of a research scale gasifier was completed in the fall of 1989; and

- Work on the beneficiation of coal including ultra-fine grinding, setting the stage for further research on advanced coal cleaning for eastern high sulphur coal.

Environment Canada's "Thermal Power Generation Emissions - National Guidelines for New Stationary Sources", previously contained in the superceded Clean Air Act, were published under the Canadian Environmental Protection Act on March 3, 1990.

8. CONCLUSION

Through the Eastern Canada Acid Rain Control Program, federal and provincial governments have demonstrated a willingness and an ability to work together in developing and implementing measures that are broad in scope and direction, while respecting the requirements of different jurisdictions and the need for regional flexibility.

Overall, the Canadian acid rain control program is on target for meeting the 1994 objective. The allocation of the final 174 kilotonnes of emission reductions necessary to achieve the total emission reduction target of 2300 kilotonnes is still to be committed.

Canadian SO_2 emissions are continuing to decline, transboundary flows into the United States are being reduced and, through the development and deployment of new technologies, progress is being made to forestall any future increases.